

ET530801627US

**APPLICATION  
FOR  
UNITED STATES LETTERS PATENT**

INTERNATIONAL BUSINESS MACHINES CORPORATION

A METHOD AND SYSTEM FOR CONTROLLING USE OF SOFTWARE  
PROGRAMS

Field of Invention

5 The present invention relates to a method and system for controlling use of software programs.

Background of the Invention

10 Software programs running on a computer can be perfectly reproduced in an infinite number of copies. This is a major concern for publishers of the programs wishing to protect their intellectual property rights; as a matter of fact, the publishers typically receive a royalty for a licensed use of each program, so that any unaccounted use or distribution of the program results in an unpaid royalty. The problem has been exacerbated in the last years by the widespread diffusion of the INTERNET, which further facilitates the uncontrolled distribution of this kind of products.

20 The most straightforward way of avoiding unaccounted usage of the programs is that of preventing unauthorized copying and transmission. For example, most programs embed control code that limits the number of copies that can be made or disables operation of the programs after a predetermined period of time has lapsed. Another 25 technique consists of requiring possession of a software or hardware key for running the programs.

A different solution proposed in the art is that of installing a licensing management system on the computer, which system controls compliance of the programs running on the computer with respective conditions of use

5 authorised by the publisher (for example defining the maximum computational power of the computer on which the program can run). More specifically, the authorised conditions of use for each program (translated into machine-readable form) are embedded into a digital

10 license certificate. The program includes a call to the licensing management system, so that each time an end-user requires execution of the program a corresponding request is transferred to the licensing management system. The licensing management system verifies whether the running of the program falls within the limits set out by the authorised conditions of use embedded in the license certificate; the licensing management system enables or prevents execution of the program according to the result of the verification.

20

However, the solution described above is not completely satisfactory. Particularly, running of the licensing management system requires the full function of an operating system and other programs providing basic services for the computer. Therefore, each time the computer is switched on a bootstrap process is at first executed, during which the basic programs are loaded. Once the bootstrap has been completed, providing a software platform on top of which other programs can run, 25 the licensing management system can be started.

30

As a consequence, all the basic programs that are loaded during the bootstrap process (such as the operating system itself, a network stack, and the like) cannot be monitored by the licensing management system. 5 This prevents carrying out a full control of the programs running on the computer. The aforementioned drawback is particularly critical, since the programs escaping the control are generally of a great worth. Therefore, the economic lost suffered by the publishers of the programs 10 may be considerable.

It is an object of the present invention to overcome the above-mentioned drawbacks. In order to achieve this object, a method as set out in claims 1 and 10 is 15 proposed.

#### Disclosure of the Invention

Briefly, the present invention provides a method of controlling use of software programs on a computer including the steps of starting a bootstrap involving loading at least one software program providing basic services for the computer, and requesting an execution authorisation by each program to a licensing management system; the method further includes the steps of granting the authorisation according to a preliminary verification of licensing information indicative of an authorised condition of use of the program before completion of the bootstrap, and revising the granted authorisation according to a complete verification of the licensing 20 information after completion of the bootstrap.

Alternatively, the present invention provides a method of controlling use of software programs on a computer including the steps of requesting an execution authorisation by each program to a licensing management system, and granting the authorisation according to a verification of licensing information indicative of an authorised condition of use of the program; the method further includes the steps of monitoring operation of the computer for detecting a change in an execution environment of the program, and revising the granted authorisation according to the detected change.

Moreover, the present invention also provides computer programs for performing these methods, products storing the programs, and corresponding systems for controlling use of the software programs.

#### Brief Description of the Drawings

Further features and the advantages of the solution according to the present invention will be made clear by the following description of a preferred embodiment thereof, given purely by way of a non-restrictive indication, with reference to the attached figures, in which:

Fig.1 is a basic block diagram of a networking system in which the method of the invention can be used;

Fig.2 shows a partial content of a working memory of a client workstation and of a server workstation included in the networking system;

Figg.3a-3c are a flow chart of a method for controlling use of software programs on the client workstation.

5 Description of the Preferred Embodiments

With reference in particular to Fig. 1, there is shown a networking system 100, such as a LAN (Local Area Network). The LAN 100 is formed by a plurality of workstations 105, typically consisting of PCs (Personal Computers). The workstations 105 are connected to one or more concentrators 110 (such as hubs) through respective communication cables 115. The networking system 100 has a client/server architecture, wherein one or more of the workstations 105 (generally consisting of powerful computers) manage network resources, such as shared files and devices; the other workstations 105 operate as clients on which users run applications relying on server resources.

20 Each workstation 105 includes several units, which are connected in parallel to a communication bus 120. In particular, a central processing unit (CPU) 125 controls operation of the workstation 105, a working memory 130 (typically a DRAM) is used directly by the CPU 125, and a read-only memory (ROM) 135 stores a basic program for 25 starting the workstation 105. Various peripheral units are further connected to the bus 120 (by means of respective interfaces). Particularly, a bulk memory consists of a hard-disk 140 and of a driver unit (DRV) 145 for reading CD-ROMs 150; the workstation 105 further

includes an input unit (IN) 155, which consists for example of a keyboard and a mouse, and an output unit (OUT) 160, which consists for example of a monitor. A network interface card (NIC) 165 is used to connect the 5 workstation 105 to the concentrator 110 (through the communication cable 115).

Similar considerations apply if the networking system consists of a WAN (Wide Area Network), if the 10 networking system includes different components (such as one or more switches), if each workstation has a different structure (for example with a multi-processor architecture), if the networking system is replaced by a main frame with a series of terminals, or by any other 15 data processing system with one or more computers.

Considering now Fig.2, there is shown a partial content of the working memory (denoted with 130c) of a 20 workstation operating as a client and of the working memory (denoted with 130s) of a workstation operating as a licensing server; the information (programs and data) 25 is typically stored on the hard-disks and loaded (at least partially) into the working memories 103c,130s when the programs are running. The programs are initially installed onto the hard disks of the client workstation and of the server workstation from CD-ROM.

An operating system (OS) 205c and an operating 30 system 205s provide a software platform for the client workstation and for the server workstation, respectively,

on top of which other programs can run; the operating systems 205c,205s perform basic tasks, such as 5  
recognising input from the keyboard, sending output to the monitor, keeping track of files on the hard-disk, and so on. A main module of each operating system 205c,205s (known as kernel) is resident in the respective working memory 103c,130s. The kernel provides all the essential services required by other parts of the operating system 205c,205s (such as loading programs into the working 10  
memory, scheduling processes, or interpreting commands). A stack (STACK) 215c and a stack 215s process a set of network protocol layers working together for defining communication over the networking system. Particularly, the stacks 215c,215s allow the client workstation and the server workstation to exchange messages between them.

20  
A licensing management application (LMA) 220 controls a database of digital license certificates (CERT) 225 stored on the server workstation. A different license certificate 225 is employed to authorise use of each software program running on the networking system. The license certificate 225 includes an identifier of the certificate, an identifier of a publisher of the program, conditions of use of the program as authorised by the 25  
publisher, and exceptional conditions of use (outside the authorised ones) under which the program can still run.

30  
For example, the authorised conditions of use of the program defines the maximum power of the CPU or the maximum capacity of the working memory of the workstation

on which the program can run, the maximum number of  
end-users allowed to run the program simultaneously, and  
the like. Moreover, the publisher exceptionally allows  
the program to run even when the actual conditions of use  
5 exceed the authorised ones of a pre-set percentage (such  
as 10%); for example, if the program is authorised to run  
on a workstation with a maximum power of the CPU equal to  
100 MIPS, the program is still allowed to run (under the  
exceptional conditions of use) even if the power of the  
10 CPU increases up to 110 MIPS.

20  
25  
30  
35  
40  
45  
50  
55  
60  
65  
70  
75  
80  
85  
90  
95  
100  
105  
110  
115  
120  
125  
130  
135  
140  
145  
150  
155  
160  
165  
170  
175  
180  
185  
190  
195  
200  
205  
210  
215  
220  
225  
230  
235  
240  
245  
250  
255  
260  
265  
270  
275  
280  
285  
290  
295  
300  
305  
310  
315  
320  
325  
330  
335  
340  
345  
350  
355  
360  
365  
370  
375  
380  
385  
390  
395  
400  
405  
410  
415  
420  
425  
430  
435  
440  
445  
450  
455  
460  
465  
470  
475  
480  
485  
490  
495  
500  
505  
510  
515  
520  
525  
530  
535  
540  
545  
550  
555  
560  
565  
570  
575  
580  
585  
590  
595  
600  
605  
610  
615  
620  
625  
630  
635  
640  
645  
650  
655  
660  
665  
670  
675  
680  
685  
690  
695  
700  
705  
710  
715  
720  
725  
730  
735  
740  
745  
750  
755  
760  
765  
770  
775  
780  
785  
790  
795  
800  
805  
810  
815  
820  
825  
830  
835  
840  
845  
850  
855  
860  
865  
870  
875  
880  
885  
890  
895  
900  
905  
910  
915  
920  
925  
930  
935  
940  
945  
950  
955  
960  
965  
970  
975  
980  
985  
990  
995  
1000  
1005  
1010  
1015  
1020  
1025  
1030  
1035  
1040  
1045  
1050  
1055  
1060  
1065  
1070  
1075  
1080  
1085  
1090  
1095  
1100  
1105  
1110  
1115  
1120  
1125  
1130  
1135  
1140  
1145  
1150  
1155  
1160  
1165  
1170  
1175  
1180  
1185  
1190  
1195  
1200  
1205  
1210  
1215  
1220  
1225  
1230  
1235  
1240  
1245  
1250  
1255  
1260  
1265  
1270  
1275  
1280  
1285  
1290  
1295  
1300  
1305  
1310  
1315  
1320  
1325  
1330  
1335  
1340  
1345  
1350  
1355  
1360  
1365  
1370  
1375  
1380  
1385  
1390  
1395  
1400  
1405  
1410  
1415  
1420  
1425  
1430  
1435  
1440  
1445  
1450  
1455  
1460  
1465  
1470  
1475  
1480  
1485  
1490  
1495  
1500  
1505  
1510  
1515  
1520  
1525  
1530  
1535  
1540  
1545  
1550  
1555  
1560  
1565  
1570  
1575  
1580  
1585  
1590  
1595  
1600  
1605  
1610  
1615  
1620  
1625  
1630  
1635  
1640  
1645  
1650  
1655  
1660  
1665  
1670  
1675  
1680  
1685  
1690  
1695  
1700  
1705  
1710  
1715  
1720  
1725  
1730  
1735  
1740  
1745  
1750  
1755  
1760  
1765  
1770  
1775  
1780  
1785  
1790  
1795  
1800  
1805  
1810  
1815  
1820  
1825  
1830  
1835  
1840  
1845  
1850  
1855  
1860  
1865  
1870  
1875  
1880  
1885  
1890  
1895  
1900  
1905  
1910  
1915  
1920  
1925  
1930  
1935  
1940  
1945  
1950  
1955  
1960  
1965  
1970  
1975  
1980  
1985  
1990  
1995  
2000  
2005  
2010  
2015  
2020  
2025  
2030  
2035  
2040  
2045  
2050  
2055  
2060  
2065  
2070  
2075  
2080  
2085  
2090  
2095  
2100  
2105  
2110  
2115  
2120  
2125  
2130  
2135  
2140  
2145  
2150  
2155  
2160  
2165  
2170  
2175  
2180  
2185  
2190  
2195  
2200  
2205  
2210  
2215  
2220  
2225  
2230  
2235  
2240  
2245  
2250  
2255  
2260  
2265  
2270  
2275  
2280  
2285  
2290  
2295  
2300  
2305  
2310  
2315  
2320  
2325  
2330  
2335  
2340  
2345  
2350  
2355  
2360  
2365  
2370  
2375  
2380  
2385  
2390  
2395  
2400  
2405  
2410  
2415  
2420  
2425  
2430  
2435  
2440  
2445  
2450  
2455  
2460  
2465  
2470  
2475  
2480  
2485  
2490  
2495  
2500  
2505  
2510  
2515  
2520  
2525  
2530  
2535  
2540  
2545  
2550  
2555  
2560  
2565  
2570  
2575  
2580  
2585  
2590  
2595  
2600  
2605  
2610  
2615  
2620  
2625  
2630  
2635  
2640  
2645  
2650  
2655  
2660  
2665  
2670  
2675  
2680  
2685  
2690  
2695  
2700  
2705  
2710  
2715  
2720  
2725  
2730  
2735  
2740  
2745  
2750  
2755  
2760  
2765  
2770  
2775  
2780  
2785  
2790  
2795  
2800  
2805  
2810  
2815  
2820  
2825  
2830  
2835  
2840  
2845  
2850  
2855  
2860  
2865  
2870  
2875  
2880  
2885  
2890  
2895  
2900  
2905  
2910  
2915  
2920  
2925  
2930  
2935  
2940  
2945  
2950  
2955  
2960  
2965  
2970  
2975  
2980  
2985  
2990  
2995  
3000  
3005  
3010  
3015  
3020  
3025  
3030  
3035  
3040  
3045  
3050  
3055  
3060  
3065  
3070  
3075  
3080  
3085  
3090  
3095  
3100  
3105  
3110  
3115  
3120  
3125  
3130  
3135  
3140  
3145  
3150  
3155  
3160  
3165  
3170  
3175  
3180  
3185  
3190  
3195  
3200  
3205  
3210  
3215  
3220  
3225  
3230  
3235  
3240  
3245  
3250  
3255  
3260  
3265  
3270  
3275  
3280  
3285  
3290  
3295  
3300  
3305  
3310  
3315  
3320  
3325  
3330  
3335  
3340  
3345  
3350  
3355  
3360  
3365  
3370  
3375  
3380  
3385  
3390  
3395  
3400  
3405  
3410  
3415  
3420  
3425  
3430  
3435  
3440  
3445  
3450  
3455  
3460  
3465  
3470  
3475  
3480  
3485  
3490  
3495  
3500  
3505  
3510  
3515  
3520  
3525  
3530  
3535  
3540  
3545  
3550  
3555  
3560  
3565  
3570  
3575  
3580  
3585  
3590  
3595  
3600  
3605  
3610  
3615  
3620  
3625  
3630  
3635  
3640  
3645  
3650  
3655  
3660  
3665  
3670  
3675  
3680  
3685  
3690  
3695  
3700  
3705  
3710  
3715  
3720  
3725  
3730  
3735  
3740  
3745  
3750  
3755  
3760  
3765  
3770  
3775  
3780  
3785  
3790  
3795  
3800  
3805  
3810  
3815  
3820  
3825  
3830  
3835  
3840  
3845  
3850  
3855  
3860  
3865  
3870  
3875  
3880  
3885  
3890  
3895  
3900  
3905  
3910  
3915  
3920  
3925  
3930  
3935  
3940  
3945  
3950  
3955  
3960  
3965  
3970  
3975  
3980  
3985  
3990  
3995  
4000  
4005  
4010  
4015  
4020  
4025  
4030  
4035  
4040  
4045  
4050  
4055  
4060  
4065  
4070  
4075  
4080  
4085  
4090  
4095  
4100  
4105  
4110  
4115  
4120  
4125  
4130  
4135  
4140  
4145  
4150  
4155  
4160  
4165  
4170  
4175  
4180  
4185  
4190  
4195  
4200  
4205  
4210  
4215  
4220  
4225  
4230  
4235  
4240  
4245  
4250  
4255  
4260  
4265  
4270  
4275  
4280  
4285  
4290  
4295  
4300  
4305  
4310  
4315  
4320  
4325  
4330  
4335  
4340  
4345  
4350  
4355  
4360  
4365  
4370  
4375  
4380  
4385  
4390  
4395  
4400  
4405  
4410  
4415  
4420  
4425  
4430  
4435  
4440  
4445  
4450  
4455  
4460  
4465  
4470  
4475  
4480  
4485  
4490  
4495  
4500  
4505  
4510  
4515  
4520  
4525  
4530  
4535  
4540  
4545  
4550  
4555  
4560  
4565  
4570  
4575  
4580  
4585  
4590  
4595  
4600  
4605  
4610  
4615  
4620  
4625  
4630  
4635  
4640  
4645  
4650  
4655  
4660  
4665  
4670  
4675  
4680  
4685  
4690  
4695  
4700  
4705  
4710  
4715  
4720  
4725  
4730  
4735  
4740  
4745  
4750  
4755  
4760  
4765  
4770  
4775  
4780  
4785  
4790  
4795  
4800  
4805  
4810  
4815  
4820  
4825  
4830  
4835  
4840  
4845  
4850  
4855  
4860  
4865  
4870  
4875  
4880  
4885  
4890  
4895  
4900  
4905  
4910  
4915  
4920  
4925  
4930  
4935  
4940  
4945  
4950  
4955  
4960  
4965  
4970  
4975  
4980  
4985  
4990  
4995  
5000  
5005  
5010  
5015  
5020  
5025  
5030  
5035  
5040  
5045  
5050  
5055  
5060  
5065  
5070  
5075  
5080  
5085  
5090  
5095  
5100  
5105  
5110  
5115  
5120  
5125  
5130  
5135  
5140  
5145  
5150  
5155  
5160  
5165  
5170  
5175  
5180  
5185  
5190  
5195  
5200  
5205  
5210  
5215  
5220  
5225  
5230  
5235  
5240  
5245  
5250  
5255  
5260  
5265  
5270  
5275  
5280  
5285  
5290  
5295  
5300  
5305  
5310  
5315  
5320  
5325  
5330  
5335  
5340  
5345  
5350  
5355  
5360  
5365  
5370  
5375  
5380  
5385  
5390  
5395  
5400  
5405  
5410  
5415  
5420  
5425  
5430  
5435  
5440  
5445  
5450  
5455  
5460  
5465  
5470  
5475  
5480  
5485  
5490  
5495  
5500  
5505  
5510  
5515  
5520  
5525  
5530  
5535  
5540  
5545  
5550  
5555  
5560  
5565  
5570  
5575  
5580  
5585  
5590  
5595  
5600  
5605  
5610  
5615  
5620  
5625  
5630  
5635  
5640  
5645  
5650  
5655  
5660  
5665  
5670  
5675  
5680  
5685  
5690  
5695  
5700  
5705  
5710  
5715  
5720  
5725  
5730  
5735  
5740  
5745  
5750  
5755  
5760  
5765  
5770  
5775  
5780  
5785  
5790  
5795  
5800  
5805  
5810  
5815  
5820  
5825  
5830  
5835  
5840  
5845  
5850  
5855  
5860  
5865  
5870  
5875  
5880  
5885  
5890  
5895  
5900  
5905  
5910  
5915  
5920  
5925  
5930  
5935  
5940  
5945  
5950  
5955  
5960  
5965  
5970  
5975  
5980  
5985  
5990  
5995  
6000  
6005  
6010  
6015  
6020  
6025  
6030  
6035  
6040  
6045  
6050  
6055  
6060  
6065  
6070  
6075  
6080  
6085  
6090  
6095  
6100  
6105  
6110  
6115  
6120  
6125  
6130  
6135  
6140  
6145  
6150  
6155  
6160  
6165  
6170  
6175  
6180  
6185  
6190  
6195  
6200  
6205  
6210  
6215  
6220  
6225  
6230  
6235  
6240  
6245  
6250  
6255  
6260  
6265  
6270  
6275  
6280  
6285  
6290  
6295  
6300  
6305  
6310  
6315  
6320  
6325  
6330  
6335  
6340  
6345  
6350  
6355  
6360  
6365  
6370  
6375  
6380  
6385  
6390  
6395  
6400  
6405  
6410  
6415  
6420  
6425  
6430  
6435  
6440  
6445  
6450  
6455  
6460  
6465  
6470  
6475  
6480  
6485  
6490  
6495  
6500  
6505  
6510  
6515  
6520  
6525  
6530  
6535  
6540  
6545  
6550  
6555  
6560  
6565  
6570  
6575  
6580  
6585  
6590  
6595  
6600  
6605  
6610  
6615  
6620  
6625  
6630  
6635  
6640  
6645  
6650  
6655  
6660  
6665  
6670  
6675  
6680  
6685  
6690  
6695  
6700  
6705  
6710  
6715  
6720  
6725  
6730  
6735  
6740  
6745  
6750  
6755  
6760  
6765  
6770  
6775  
6780  
6785  
6790  
6795  
6800  
6805  
6810  
6815  
6820  
6825  
6830  
6835  
6840  
6845  
6850  
6855  
6860  
6865  
6870  
6875  
6880  
6885  
6890  
6895  
6900  
6905  
6910  
6915  
6920  
6925  
6930  
6935  
6940  
6945  
6950  
6955  
6960  
6965  
6970  
6975  
6980  
6985  
6990  
6995  
7000  
7005  
7010  
7015  
7020  
7025  
7030  
7035  
7040  
7045  
7050  
7055  
7060  
7065  
7070  
7075  
7080  
7085  
7090  
7095  
7100  
7105  
7110  
7115  
7120  
7125  
7130  
7135  
7140  
7145  
7150  
7155  
7160  
7165  
7170  
7175  
7180  
7185  
7190  
7195  
7200  
7205  
7210  
7215  
7220  
7225  
7230  
7235  
7240  
7245  
7250  
7255  
7260  
7265  
7270  
7275  
7280  
7285  
7290  
7295  
7300  
7305  
7310  
7315  
7320  
7325  
7330  
7335  
7340  
7345  
7350  
7355  
7360  
7365  
7370  
7375  
7380  
7385  
7390  
7395  
7400  
7405  
7410  
7415  
7420  
7425  
7430  
7435  
7440  
7445  
7450  
7455  
7460  
7465  
7470  
7475  
7480  
7485  
7490  
7495  
7500  
7505  
7510  
7515  
7520  
7525  
7530  
7535  
7540  
7545  
7550  
7555  
7560  
7565  
7570  
7575  
7580  
7585  
7590  
7595  
7600  
7605  
7610  
7615  
7620  
7625  
7630  
7635  
7640  
7645  
7650  
7655  
7660  
7665  
7670  
7675  
7680  
7685  
7690  
7695  
7700  
7705  
7710  
7715  
7720  
7725  
7730  
7735  
7740  
7745  
7750  
7755  
7760  
7765  
7770  
7775  
7780  
7785  
7790  
7795  
7800  
7805  
7810  
7815  
7820  
7825  
7830  
7835  
7840  
7845  
7850  
7855  
7860  
7865  
7870  
7875  
7880  
7885  
7890  
7895  
7900  
7905  
7910  
7915  
7920  
7925  
7930  
7935  
7940  
7945  
7950  
7955  
7960  
7965  
7970  
7975  
7980  
7985  
7990  
7995  
8000  
8005  
8010  
8015  
8020  
8025  
8030  
8035  
8040  
8045  
8050  
8055  
8060  
8065  
8070  
8075  
8080  
8085  
8090  
8095  
8100  
8105  
8110  
8115  
8120  
8125  
8130  
8135  
8140  
8145  
8150  
8155  
8160  
8165  
8170  
8175  
8180  
8185  
8190  
8195  
8200  
8205  
8210  
8215  
8220  
8225  
8230  
8235  
8240  
8245  
8250  
8255  
8260  
8265  
8270  
8275  
8280  
8285  
8290  
8295  
8300  
8305  
8310  
8315  
8320  
8325  
8330  
8335  
8340  
8345  
8350  
8355  
8360  
8365  
8370  
8375  
8380  
8385  
8390  
8395  
8400  
8405  
8410  
8415  
8420  
8425  
8430  
8435  
8440  
8445  
8450  
8455  
8460  
8465  
8470  
8475  
8480  
8485  
8490  
8495  
8500  
8505  
8510  
8515  
8520  
8525  
8530  
8535  
8540  
8545  
8550  
8555  
8560  
8565  
8570  
8575  
8580  
8585  
8590  
8595  
8600  
8605  
8610  
8615  
8620  
8625  
8630  
8635  
8640  
8645  
8650  
8655  
8660  
8665  
8670  
8675  
8680  
8685  
8690  
8695  
8700  
8705  
8710  
8715  
8720  
8725  
8730  
8735  
8740  
8745  
8750  
8755  
8760  
8765  
8770  
8775  
8780  
8785  
8790  
8795  
8800  
8805  
8810  
8815  
8820  
8825  
8830  
8835  
8840  
8845  
8850  
8855  
8860  
8865  
8870  
8875  
8880  
8885  
8890  
8895  
8900  
8905  
8910  
8915  
8920  
8925  
8930  
8935  
8940  
8945  
8950  
8955  
8960  
8965  
8970  
8975  
8980  
8985  
8990  
8995  
9000  
9005  
9010  
9015  
9020  
9025  
9030  
9035  
9040  
9045  
9050  
9055  
9060  
9065  
9070  
9075  
9080  
9085  
9090  
9095  
9100  
9105  
9110  
9115  
9120  
9125  
9130  
9135  
9140  
9145  
9150  
9155  
9160  
9165  
9170  
9175  
9180  
9185  
9190  
9195  
9200  
9205  
9210  
9215  
9220  
9225  
9230  
9235  
9240  
9245  
9250  
9255  
9260  
9265  
9270  
9275  
9280  
9285  
9290  
9295  
9300  
9305  
9310  
9315  
9320  
9325  
9330  
9335  
9340  
9345  
9350  
9355  
9360  
9365  
9370  
9375  
9380  
9385  
9390  
9395  
9400  
9405  
9410  
9415  
9420  
9425  
9430  
9435  
9440  
9445  
9450  
9455  
9460<br

configuration information 233 defines an execution environment of the programs running on the client workstation.

5           A full-function licensing agent (FFA) 235 is a daemon process further active on the client workstation, which provides a complete operation of the licensing management system. The full-function agent 235 communicates with the system agent 230 and with the stack 10 215c (for exchanging messages with the server workstation).

15           The system agent 235 controls a repository of local digital license certificates (LOC\_CERT) 240. Each local license certificate 240 includes a simplified copy of the corresponding license certificate 225 (stored on the server workstation). Particularly, the local license certificate 240 simply consists of an identifier of the corresponding program that is authorised to run on the client workstation. The system agent 230 further controls a log structure (LOG) 245 storing requests of authorisation or release received from the basic programs (operating system 205c and stack 215c). Application programs 250, running on top of the operating system 205c, further communicates with the system agent 230 for sending respective requests of authorisations or release. 25

30           Likewise considerations apply if the programs and data are structured in a different manner, if other modules or functions are provided, if different

conditions of use are envisaged, if the programs are not allowed to run outside the authorised conditions of use, if one or more different programs providing basic services for the client workstation are provided (down to 5 the operating system alone), and so on.

As shown in Figg.3a-3c, a series of routines, which together make up a method 300, are performed at successive stages in time in order to control usage of the programs installed on the client workstation. The 10 method 300 starts at block 303 and then passes to block 306, wherein the client workstation is turned on. As a consequence, the CPU loads the basic program stored in the ROM memory (after stabilization of an internal power supply); the basic program performs a test of the installed hardware and initialises the client 15 workstation. The basic program then identifies a peripheral unit storing a boot code for starting the operating system; this code takes over the basic program and starts a bootstrap process. The bootstrap involves 20 loading utilities providing essential services for the client workstation, which in turn control loading and execution of the rest of the operating system and of the other basic programs (such as the network stack) as the 25 bootstrap progresses.

Continuing to block 309, the system agent of the 30 licensing management system is loaded during the bootstrap (as part of the kernel of the operating system). The system agent checks at block 311 whether a

basic program (that is the operating system or the network stack in the example at issue) has been started or terminated during the bootstrap.

5        If no action has been notified to the system agent, the method descends into block 312 (described in the following). Conversely, when a basic problem starts it requests an execution authorisation to the system agent (after a loading of the system agent has been completed).  
10      As a consequence, the system agent verifies the repository of the local license certificates at block 318. If a local license certificate for the basic program is found (indicating that the basic program is authorised to run), the system agent enables execution of the basic program at block 321, and then logs the request of authorisation at block 322; conversely, the execution of the basic program is aborted, and the method enters an error condition at block 324 (which is typically logged for further analysis). In both cases, the method continues to block 312. When a basic program terminates its execution (block 311), the basic program notifies the system agent accordingly (before terminating). As a consequence, the system agent logs a corresponding request of release at block 325 and then descends into block 312.

25      Considering now block 312, once the bootstrap has been terminated, the full-function agent is loaded; as soon as the loading of the full-function agent is completed, the system agent is notified accordingly. If  
30

5

the system agent has not been notified of the loading of the full-function agent yet, the method returns to block 311 for repeating the steps described above. Conversely, the method forks into two branches that are executed in parallel. A first branch consists of blocks 327-336, and a second branch consists of blocks 342-384; the two branches joint at block 387 (described in the following).

10

15

20

25

Considering now block 327, the system agent checks whether an application program has been started or terminated. If so, the system agent transfers the corresponding request of authorisation or release to the full-function agent at block 330, and the method then passes to block 333; conversely, the method descends into block 333 directly. Considering now block 333, the system agent verifies whether a change in the configuration information defining the execution environment of the (basic and application) programs running on the client workstation has occurred. If so, the new configuration information is provided to the full-function agent at block 336, and the method then proceeds to block 387; conversely, the method descends into block 387 directly.

30

At the same time, at block 342, the requests of authorisation or release from the basic programs stored during the bootstrap are extracted from the log structure by the system agent and provided to the full-function agent. The requests so obtained are sent to the server workstation at block 343 (through the respective network stacks), together with the configuration information

defining the corresponding execution environment. Continuing to block 345, the licensing management application on the server workstation verifies compliance of each request with the authorised conditions of use contained in the respective license certificate. If a license certificate matching the basic program is found, and if the basic program is running within the conditions of use authorised by the publisher (for example if the power of the CPU does not exceed the maximum value allowed) the authorisation (previously granted by the system agent) is confirmed at block 348; conversely, the method enters an error condition at block 351 (which is logged for further analysis). In both cases, a corresponding response message is sent to the full-function agent; typically, the response message includes a return code specifying whether the authorisation has been granted or refused, and in the latter case the reason of the refusal; moreover, a status code further specifies if the granted authorisation falls within the (standard) conditions of use or within the exceptional conditions of use, or further specifies the reason of the refusal in greater detail.

The method then enters block 354 (both from block 348 and from block 351), wherein a new version of the local license certificates for the basic programs is generated from the respective license certificates stored on the server workstation. The new version of the local license certificates is sent from the licensing management application to the full-function agent on the

client workstation; the full-function agent in turn causes the system agent to update the repository of the local license certificates accordingly.

5 The method then descends into block 357, wherein the full-function agent checks whether a request of authorisation or release has been required by an application program (through the system agent). If not, the method passes to block 360 (described in the following). Conversely, the request is sent to the server 10 workstation at block 363 for updating corresponding licensing information. Proceeding to block 366, if the application program has required an execution authorisation the licensing management application verifies compliance of the request with the authorised 15 conditions of use contained in the respective license certificate. If the result of the verification is positive, the authorisation is granted at block 369; conversely the method enters an error condition at block 20 372. In both cases, a corresponding response message (return code and status code) is sent to the full-function agent; the response message is in turn sent to the system agent and then returned to the application 25 program requesting the authorisation, which continues or aborts its execution accordingly.

30 The method passes to block 360 (both from block 369 and from block 372), wherein the full-function agent verifies whether new configuration information has been received from the system agent. If not, the method

descends into block 387 directly. Conversely, the new configuration information is sent to the server workstation at block 375. Passing to block 378, the licensing management application revises each granted 5 authorisation in the light of the new configuration information. If the running of each (basic and application) program still complies with the authorised conditions of use contained in the respective license certificate, the authorisation is confirmed at block 381; conversely, the method enters an error condition at block 10 384. In both cases, a corresponding response message is sent to the full-function agent, and the method continues to block 387.

Considering now block 387, a check is made whether the client workstation has been shut down. If not, the method returns to the fork point after block 312 (for repeating the steps described above). On the contrary, the method ends at the final block 390.

Likewise considerations apply if an equivalent method is performed; for example with a warm bootstrap (wherein the client workstation is reset) instead of a cold bootstrap (wherein the client workstation is turned on from an off position), if execution of the program is disabled when an error occurs, if the response message has a different structure, and so on.

More generally, the present invention provides a 30 method of controlling use of software programs on a

computer including the steps of starting a bootstrap involving loading one or more software programs providing basic services for the computer, and requesting an execution authorisation by each program to a licensing management system; the method further includes the steps of granting the authorisation according to a preliminary verification of licensing information indicative of an authorised condition of use of the program before completion of the bootstrap, and revising the granted authorisation according to a complete verification of the licensing information after completion of the bootstrap.

The solution of the invention makes it possible to implement a complete control of the programs running on the computer.

Particularly, the proposed method allows an effective monitoring (by the licensing management system) of the valuable programs that are loaded during the bootstrap process (such as the operating system and the network stack). In fact, in the solution described above the use of the programs may be controlled even before the full function of the operating system is available.

The solution according to the present invention allows the publisher to protect his or her intellectual property rights in an effective manner; in fact, any unaccounted use of both the basic programs and the application programs is prevented, avoiding any economic loss due to unpaid royalties. Alternatively, the

information so collected is employed by the publisher only for recording the real use of the programs made by the customer; for example, this information may be advantageously used for marketing or statistical applications.

5 The preferred embodiment of the invention described above offers further advantages. For example, the provision of the system agent and of the full-function agent (with the corresponding log structure) makes the 10 implementation of the licensing management system very simple; In this way, the process of the invention is completely transparent to the (basic and application) programs requiring the respective execution authorisation to the licensing management system. Moreover, the feature 15 of deferring the request of authorisation until completion of the loading of the lightweight agent allows even programs that are started very early during the bootstrap to be monitored; particularly, this solution 20 makes it possible to control use of the kernel of the operating system itself.

25 Similar considerations apply if the licensing management system is partitioned into equivalent basic and full modules, if the stored requests of authorisation or release (from the basic programs) are provided to the full-function agent in a different manner (for example if 30 they are extracted from the log structure directly), if only requests of authorisation are logged (for example if the basic programs cannot be terminated before completion

of the bootstrap), if the authorisations are requested to the system agent from the basic programs later on, and the like. However, the solution of the invention leads itself to be implemented even with a licensing management system consisting of a single module (which performs both a preliminary verification and a complete verification of the license certificates), or by logging each authorisation requested before the loading of the system agent for a later verification.

10

The solution of the invention is particularly advantageous in a networking system, wherein license certificates for the programs running on the client workstations are stored on the server workstation. In this way, the use of the programs can be controlled even before a communication facility provided by the network stack is available. Preferably, the authorisations are granted according to a verification of respective local license certificates stored on the client workstation; this feature makes the verification of the request particularly simple and fast (and then suitable for execution during the bootstrap). Moreover, the local license certificates are continually replaced with the respective new versions (received from the server workstation) after each bootstrap; this ensures that the local license certificates stored on the client workstation are always up to date, as far as possible.

25

Likewise considerations apply if the client workstation and the server workstation communicate in a

30

different manner, if computers of different type are used, if the license certificates and the local license certificates contain different information (for example an expiration date), if the local license certificates are updated with a different frequency (for example every 5 two or more bootstraps, or periodically), and so on.

Alternatively, the license certificates and the local license certificates are replaced by equivalent 10 licensing information indicative of the authorised conditions of use of the programs, the authorisation is granted according to a different preliminary verification of the licensing information and it is revised according to a different complete verification of the licensing 15 information; however, the method of the invention leads itself to be used even in a single computer, without any updating of the local license certificates, and even without any local license certificate (for example simply 20 checking the presence of the license certificates on the computer before completion of the bootstrap and verifying the authorised conditions of use after completion of the bootstrap).

Preferably, the operation of the client workstation 25 on which the programs are running is monitored for detecting any change in the execution environment of the programs; this information is used to revise the granted authorisations accordingly. In this way, it is possible to track use of the programs dynamically. For example, if 30 the client workstation allows the power of the CPU to be

changed during operation, the devised solution makes it possible to have licensing information always perfectly aligned with the actual conditions of use of the programs.

5

Similar considerations apply if different configuration parameters are considered, if operation of the client workstation is monitored in a different manner (for example with a dedicated further agent), if the granted authorisations are revised with a different frequency (for example periodically), and the like. However, the solution of the invention leads itself to be implemented even without any monitoring of the execution environment of the programs.

10

15

Advantageously, the method proposed by the present invention is implemented with a computer program, which is provided on CD-ROM.

20

25

Alternatively, the program is provided on floppy-disk, is pre-loaded onto the hard-disk, or is stored on any other computer readable medium, is sent to the computer through the network, is broadcast, or more generally is provided in any other form directly loadable into a working memory of the computer. However, the method according to the present invention leads itself to be carried out even with a hardware structure installed on the client workstation, for example integrated in a chip of semiconductor material.

30

It should be noted that the additional feature of monitoring operation of the computer is suitable to be used (alone or combined with the other additional features) even without the preliminary and complete verification of the licensing information described above.

More generally, the present invention further provides a method of controlling use of software programs on a computer including the steps of requesting an execution authorisation by each program to a licensing management system, and granting the authorisation according to a verification of licensing information indicative of an authorised condition of use of the program; the method further includes the steps of monitoring operation of the computer for detecting a change in an execution environment of the program, and revising the granted authorisation according to the detected change.

For example, in a licensing management system that does not allow use of the basic programs (such as the operating system) to be controlled, this feature is advantageously employed to track use of the application programs dynamically.

Naturally, in order to satisfy local and specific requirements, a person skilled in the art may apply to the solution described above many modifications and alterations all of which, however, are included within

the scope of protection of the invention as defined by the following claims.